



**LysM proteins regulate  
fungal development and  
are required for biocontrol  
traits in *Clonostachys rosea***

Mukesh Dubey  
Swedish University of  
Agricultural Sciences,  
Uppsala, Sweden

- Lysin motif (LysM) modules are approximately 50 amino acids long.
- Bind to N-acetylglucosamine-containing carbohydrates, chitin, chitio-oligosaccharides and peptidoglycan.
- Found in proteins from prokaryotes and eukaryotes including bacteria, fungi and plants.

# LysM protein in fungi

LysM modules in fungi



- Fungal-specific module
- Fungal/bacterial module

LysM proteins in fungi



- LysM effector
- LysM-containing protein

- Suppress chitin-triggered defense response
- Protect fungal hyphae



The vast majority of genes encoding LysM effectors and LysM-containing proteins in fungal species with distinct lifestyles, including saprotrophs and necrotrophic mycotrophs remain uncharacterized

# *Clonostachys rosea* IK726

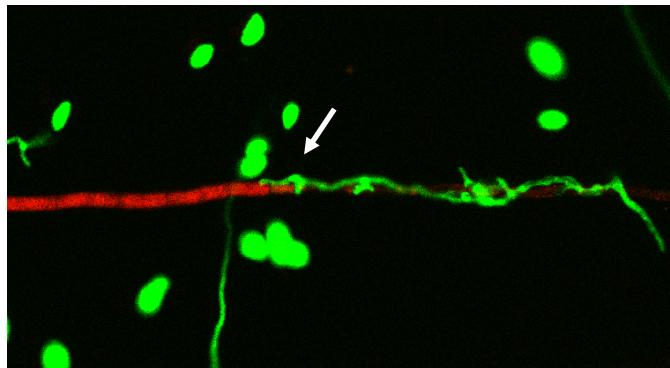
(teleomorph: *Bionectria ochroleuca*)  
Soil-borne Ascomycetes



Class, Sordariomycetes  
Order, Hypocreales  
Family, Bionectriaceae

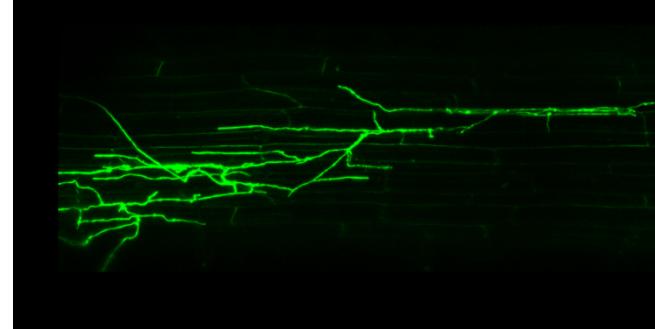
Mycoparasitic ability

Parasitization of *F. graminearum*, *R. solani* and *B. cinerea* by *C. rosea*



*C. rosea* IK726 gfp (green)  
*F. oxysporum* f. sp. *radicis lycopersici* rfp (red)

Plant root colonization ability



*C. rosea* IK726 gfp (green) colonizes tomato roots  
Karlsson et al. (2015) Genome Biology and Evolution

# LysM-containing proteins in *Clonostachys rosea*



LYSM1 (177aa)



LYSM2 (464 aa)



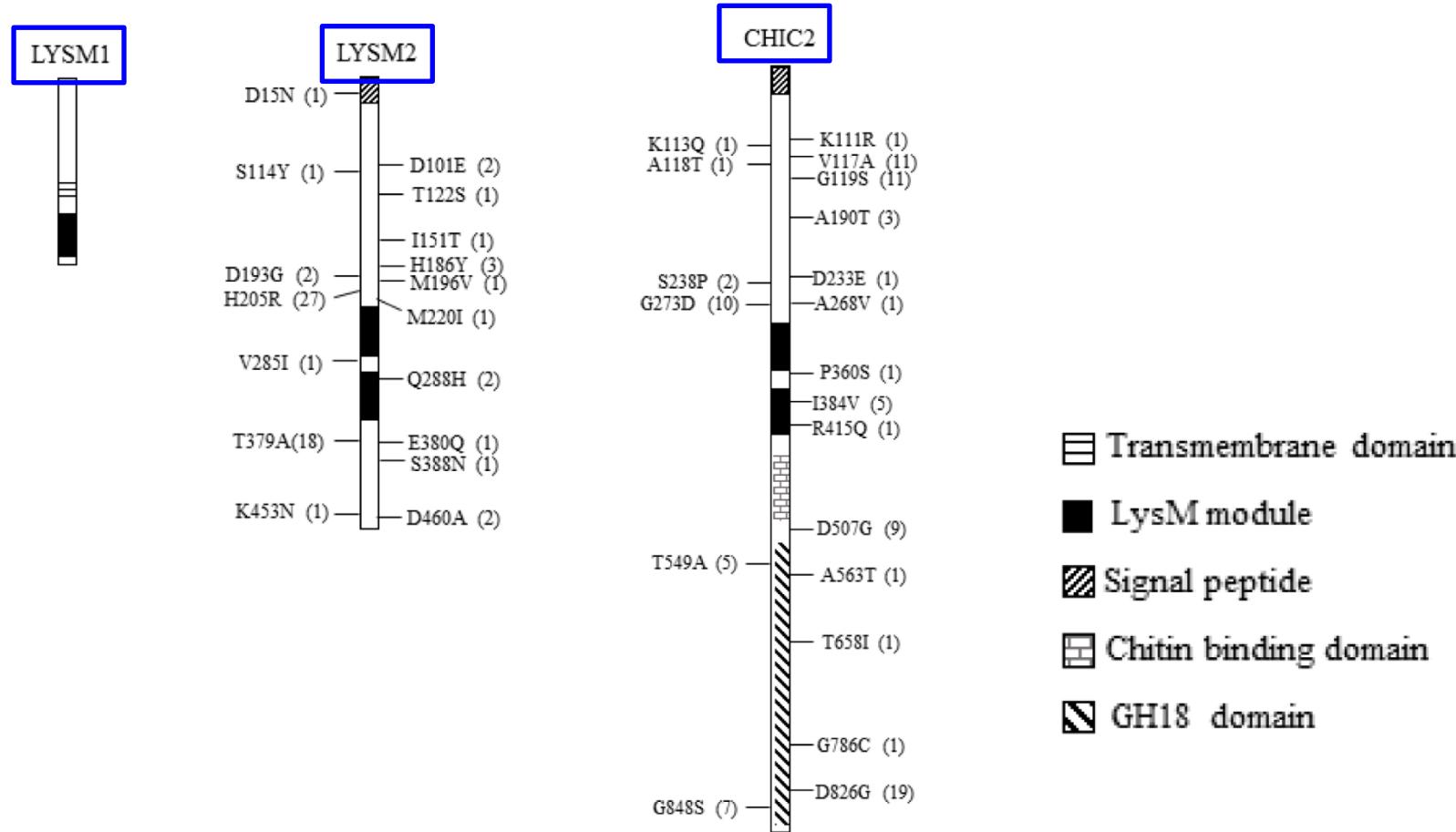
CHIC2 (866 aa)

■ LysM

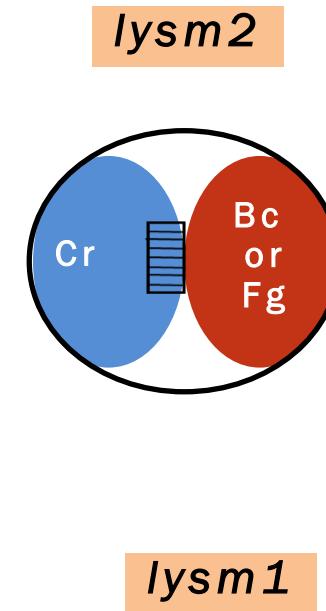
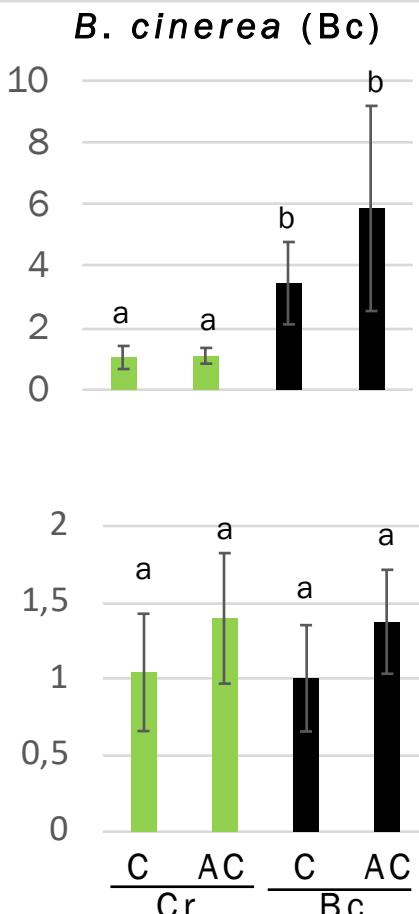
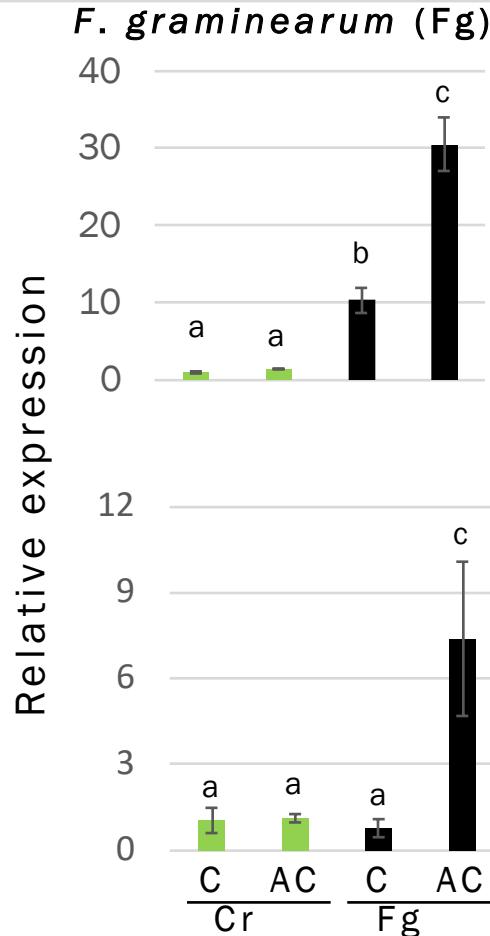
□ ChtBD1 (chitin binding domain)

□ GH18 (glycoside hydrolase)

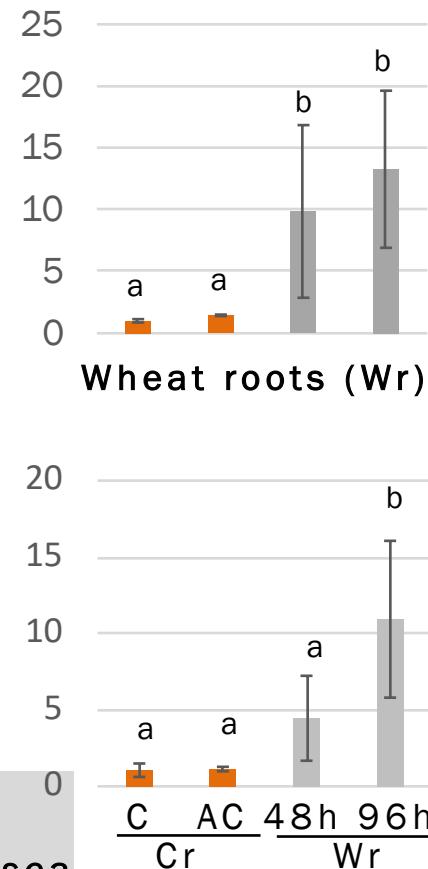
# LysM-containing proteins in *Clonostachys rosea*



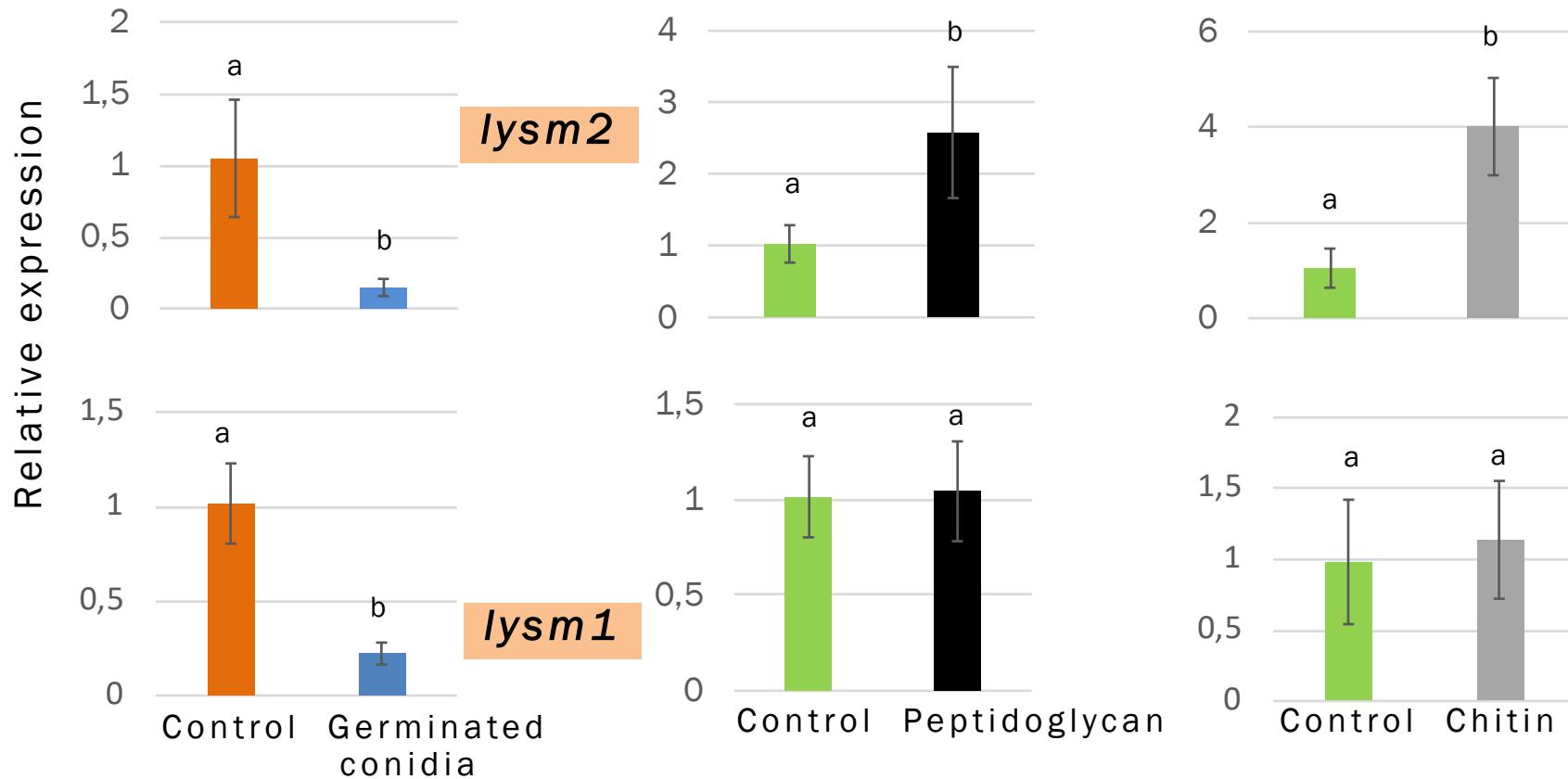
# LYSM1 and LYSM2 gene expression analyses



C = contact  
AC = after contact  
Cr = *Clonostachys rosea*



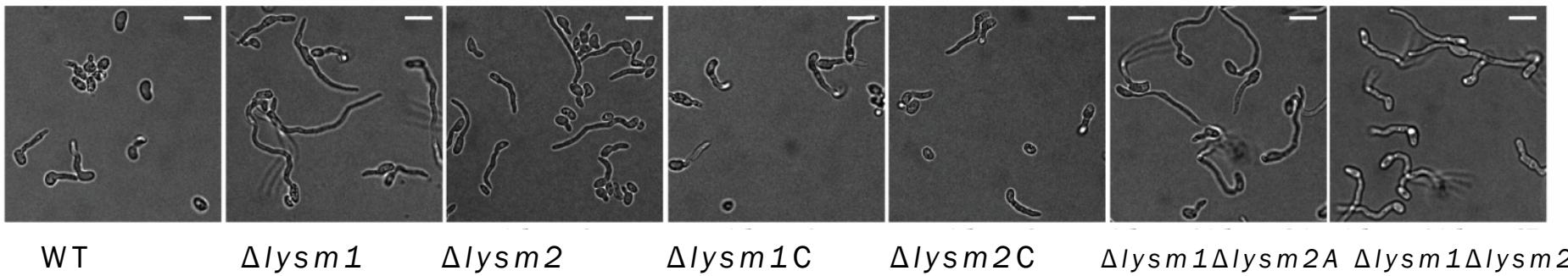
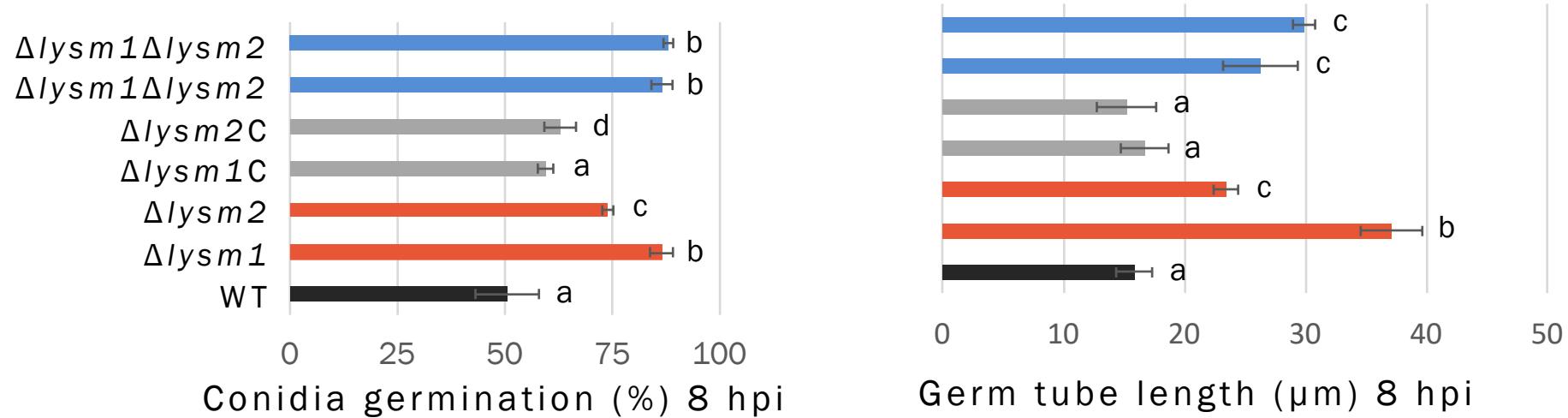
# LYSM1 and LYSM2 gene expression analysis



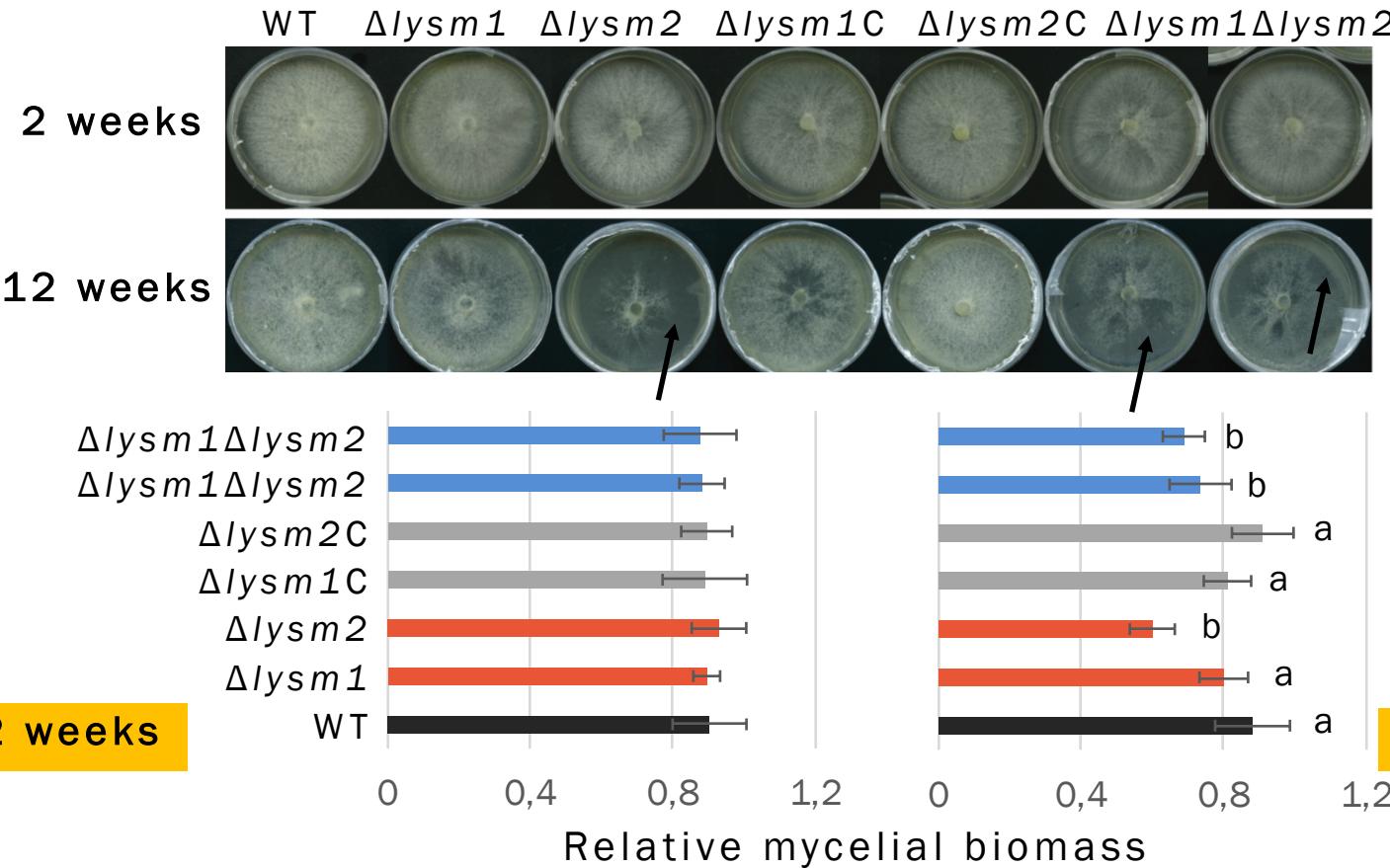
# Deletion of *lysm1* or *lysm2* affects conidial germination

ECFG15  
ROME • ITALY 2020

WT and *lysm* deletion strains showed similar growth rate and biomass

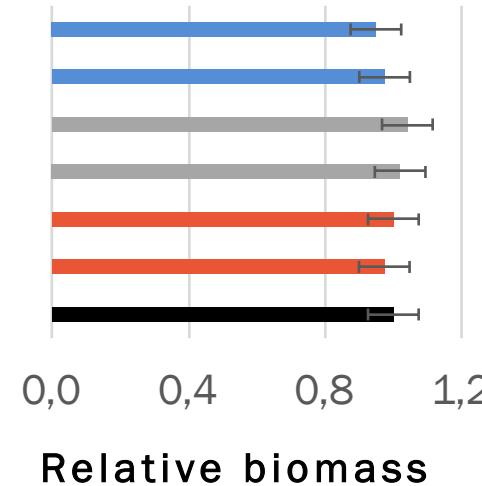
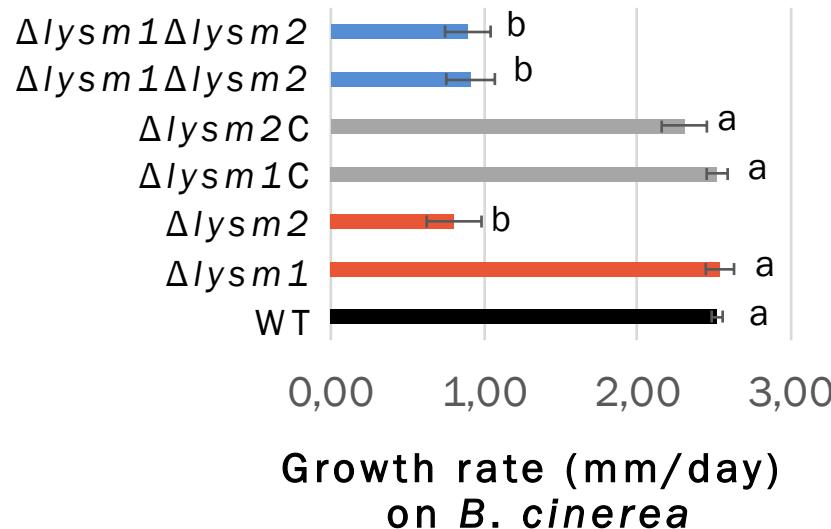
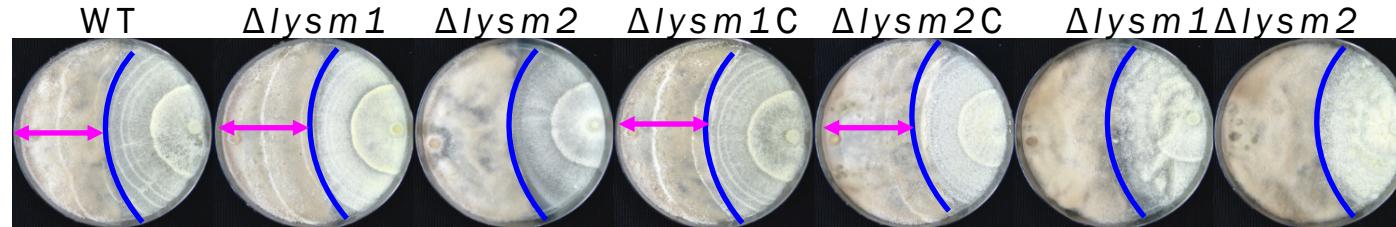


# Deletion of *lysm1* or *lysm2* affects mycelial integrity



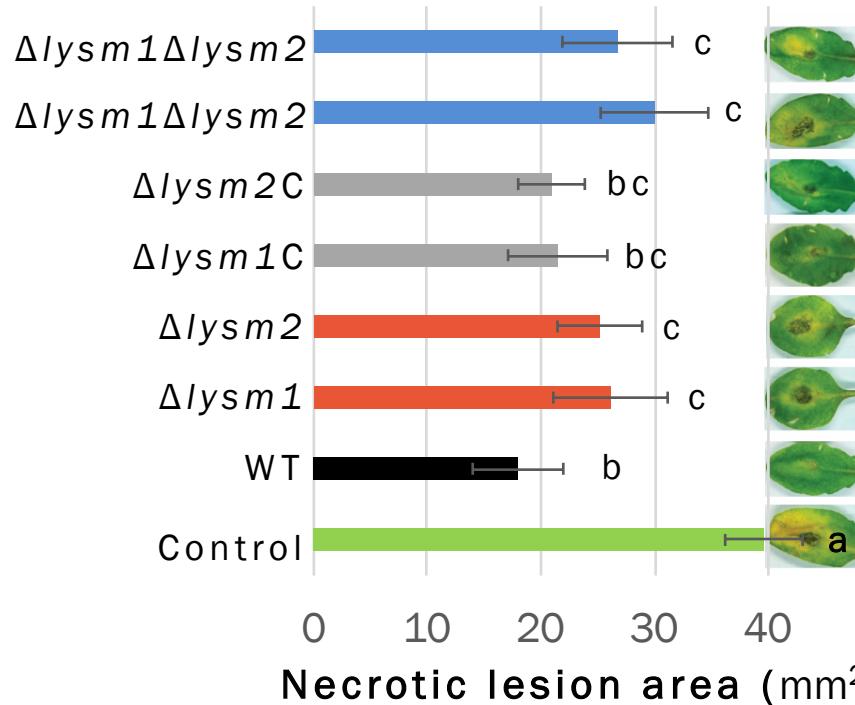
# Deletion of *lysm2* reduces antagonistic ability of *C. rosea*

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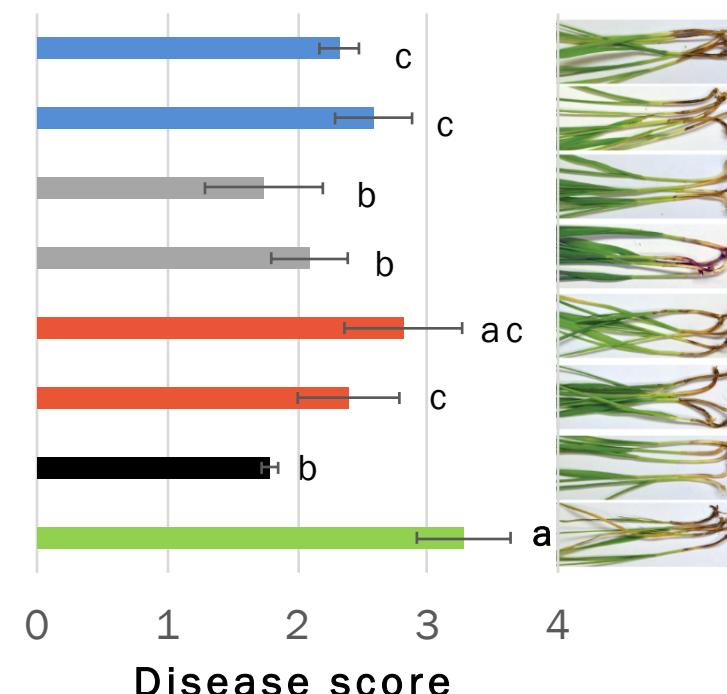


# LYSM1 and LYSM2 contributes to biocontrol

Detached leaf assay  
with *B. cinerea*



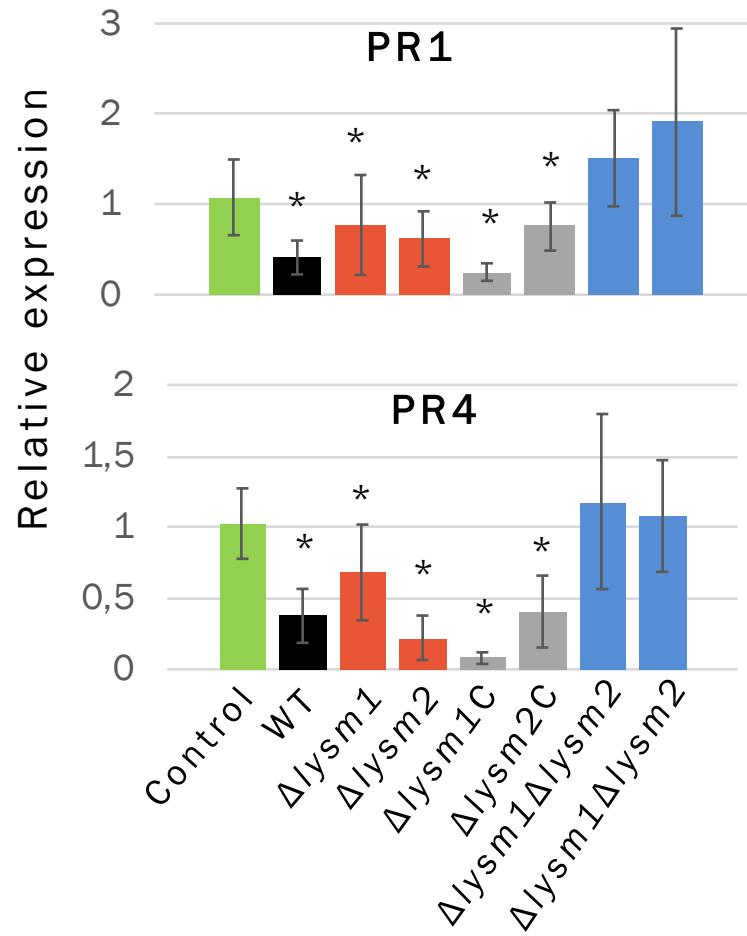
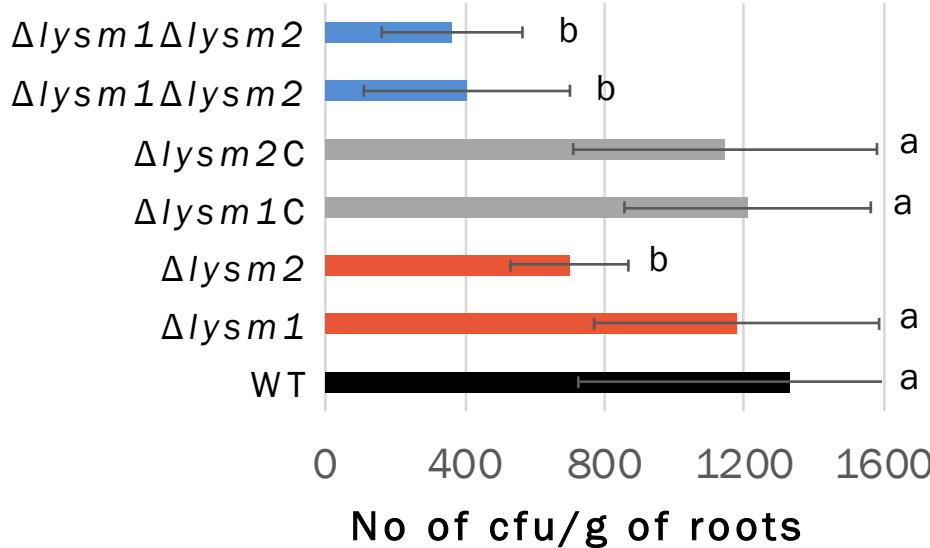
Fusarium foot rot on Wheat



# LYSM2 contributes to root colonization ability of *C. rosea*

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## Internal root colonization



# Conclusion

- We characterized the LysM-containing proteins in the mycoparasitic fungus *Clonostachys rosea*.
- Our results show that LysM proteins influence the fungal development and integrity of the hyphae.
- LysM proteins also influence the ability of *C. rosea* to control plant pathogenic fungi, and wheat root colonization.

# Acknowledgements

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FORMAS

ETT FORSKNINGSRÅD FÖR  
HÅLLBAR UTVECKLING  
A SWEDISH RESEARCH COUNCIL FOR  
SUSTAINABLE DEVELOPMENT

